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U.S. DEPARTMENT OF AGRICULTURE • Economic Research Service

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·AGRICULTURAL ECONOMICS RESEARCH VOL. 24, NO. 1, JANUARY 1972

Determinants of Net Changes in Farm Real Estate Debt

By David A. Lins

Supply and demand equations for explaining net changes in farm real estate debt by lending institutions are presented. Capital appreciation, net farm plus nonfarm income, and the ratio of money balances to gross production expenses are used to explain changes in demand. Changes in supply are measured by the yield differential between farm and nonfarm investments and availability of mortgage funds. Elasticity estimates indicate that demand is more sensitive to changes in income than to capital appreciation, while supply is sensitive to changes in yield differentials.

Key words: Farm real estate debt; demand; supply; capital appreciation; income; yield differential; supply availability.

From 1947 to 1969, farm real estate debt increased from about $5 billion to over $27 billion. Annual net changes in farm real estate debt over this period ranged from a low of $0.1 billion in 1947 to over $2.3 billion in 1965. The purpose of this paper is to measure factors underlying net changes in farm real estate debt. The results are exploratory and represent the author's hypotheses on what variables and estimation techniques best explain such changes. Others may wish to test alternative variables or estimation techniques. The presentation is intended to stimulate interest in quantifying specific relationships and to serve as potential input to future research.

Conceptually one can classify loans secured by farm real estate according to the following purposes: (1) Purchases or improvements of farm real estate assets, (2) purchases or improvements of non-real-estate assets, operating expenses, etc., and (3) nonfarm uses. The determinants of borrowing for the second and third purposes may differ substantially from those for the first. Existing data series do not allow one to adequately disaggregate loans secured by farm real estate by purpose. However, based on available evidence, it is assumed here that loans secured by farm real estate are in fact used primarily for the purchase or improvement of farm real estate assets.[1] Therefore, the following discussion relates only to determinants of borrowing for this purpose.

The determinants of net changes in farm real estate debt can be grouped in two broad categories—those affecting the supply of funds available to farm borrowers, and those affecting the demand for funds by farm borrowers.[2] A change in total debt may result from either a change in price (interest rate) or from other factors such as a change in income. From published data, one cannot generally distinguish which factors are causing changes in the level of debt outstanding. However, considerable information about supply and demand factors can be gained by examining current knowledge about the nature of the demand for real estate funds and the groups supplying funds to the farm sector.

Background

Five distinct groups supply farm mortgage funds to the farm sector: the Farmers Home Administration (Government agency), Federal Land Banks (borrower cooperative), life insurance companies, commercial banks, individuals and other. From 1947 through 1969, the amount of real estate loans outstanding to the Farmers Home Administration never exceeded 4 percent of all such loans and was as low as 1.8 percent in 1969. Federal Land Banks held about 20 percent of farm mortgage loans in 1947. The figure dropped to 15 percent in the early 1950's, and by the late 1960's had increased to about 22 percent. Life insurance companies increased their share of farm mortgage loans from about

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[1] All debt owed to production credit associations, regardless of whether it was secured by farm real estate, is excluded in references to "real estate debt" and "loans secured by farm real estate."

[2] Under this classification scheme explicit reference to several items is not made. For example, prepayments, loan extensions and loan defaults all affect the level of loans outstanding. These items are implicitly included in reference to demand related variables since they are primarily determined by income.

18 percent in 1947 to approximately 25 percent in 1957. Since 1957 the percentage has generally declined and because of recent monetary conditions this decline has accelerated. Banks and individuals have held relatively constant proportions of the total, approximately 14 and 40 percent respectively.[3]

The relative elasticities of supply for the five groups are expected to vary substantially. The supply curve of direct farm ownership loans of the Farmers Home Administration may be considered nearly perfectly inelastic in the short run because "the volume of direct lending by Farmers Home Administration is influenced more by the volume of funds appropriated rather than by supply and demand conditions" (*3*).[4] Over time, however, congressional appropriations may respond to past demands. Federal Land Banks (FLB) acquire funds though the sale of debentures on the national money markets. Since FLB acquisition of funds is small in relation to total money market demand, the supply of funds available to them, and hence to their member borrowers, might be considered perfectly elastic. Restricted supply to member borrowers is a clear possibility, however, as evidenced by the "voluntary" restrictions of 1966. Little is known about the relative elasticities of supply for other lenders.

The elasticity of net demand for farm mortgage funds has received little empirical estimation. Melichar (*6*), Brake (*1*), and Heady and Tweeten (*4*) have projected capital stocks and/or flows to 1980. However, these studies have not included estimates of elasticity of demand. A study by Hesser and Schuh (*5*) for 1921-59 found the demand for gross flows of farm mortgage funds to be elastic with respect to the rate of interest; but gross flows include refinancing of existing debt. While refinancing may be elastic with respect to interest rates, Hesser and Schuh point out that net flows (as used in this paper) are likely to be much less elastic. Also, a study by Montgomery (*7*) for 1946-68 estimated the own price elasticity for gross flows to be -0.6. These estimates are on an aggregate gross flow basis while the analysis which follows is intended to provide estimates on net flows and on an institutional basis.

A Model for Estimating Net Changes

The demand for farm real estate debt is hypothesized to be primarily a function of the cost of borrowing, capital appreciation, net farm plus nonfarm income, and the ratio of money balances to gross production expenses.[5] Changes in quantity demanded (supplied) are a function of price. The true cost of borrowing (return from lending) includes the interest rate on new loans, service charges, and some factor to reflect losses (gains) from compensating balances and other forms of rationing.

Data for these implicit costs (returns) are generally not available. Therefore, interest rates are used as a proxy for the true cost (return) of borrowing (lending). Further, data on the interest rate on new loans for the entire time period studied are available only for Federal Land Banks, while for other institutions available data reflect the average interest rate on all loans outstanding. One alternative is to use the average interest rate on loans outstanding as a proxy for the interest rate on new loans. However, since real estate loans may be outstanding for extremely long periods, sporadic movements in rates on new loans would result in a much more moderated movement in average rates. A second alternative, and the one used in this paper, is to use the rate on new loans by Federal Land Banks as a proxy for the rate on new loans by other institutions. This implicitly assumes that lending institutions are extremely sensitive to rates charged by competitors and will react accordingly.

The level of capital appreciation represents current or future returns to investment in real estate. Since capital appreciation also provides increases in equity which can be used as collateral for additional borrowing, it is expected to show a positive relationship with changes in farm real estate debt. Net farm plus nonfarm income is also expected to show a positive relationship since net farm income is a measure of current returns to the factors of production and perhaps forms the main basis for expected future returns, while nonfarm income may provide a greater base for debt expansion. Money balances held by the farm sector may be used to repay debt, purchase farm or nonfarm assets and services, or meet farm production expenses. If the ratio of money balances to gross farm production expenses is high, then repayment of debt or purchases on a cash basis are more likely to occur than if the ratio is low. Therefore, one might expect a negative relationship between the ratio of money balances to gross farm production expenses and net changes in real estate debt.

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[3] Calculated from data in Agricultural Finance Review Supplement, Vol. 30, January 1970, p. 2.

[4] Italic numbers in parentheses indicate items in References, p. 8.

[5] Other determinants of the demand for farm mortgage funds include availability of substitutes for the purchase of land (renting land), the rate of technical progress, liquidity preferences of borrowers, etc. However, due to the lack of information to adequately measure these factors, they have not been included here.

Changes in supply are hypothesized to be primarily a function of the spread between yields on investments in farm mortgages and nonfarm investment alternatives as well as the quantity of loanable funds available for investment. As the total quantity of loanable funds increases, one would expect the supply to the farm sector to increase, other things equal. Likewise, as the spread between returns on investment in farm mortgages and nonfarm investments increases, one would expect the quantity of funds supplied to the farm sector to increase, and vice versa. Commercial banks and life insurance companies generally select among alternative investments on the basis of comparative default risk, liquidity, and rate of return. Since measures of differences in liquidity and default risk are not readily available, only differences in rate of return will be tested here.

The specific form of the model tested in this paper and the estimation procedures used are presented below:

Equation			Estimation procedure
(1.1)	$Q_{DFLB} = f(X_1, X_2, X_3, X_4)$	demand	OLS
(2.1)	$Y_1 = f(Y_2, X_1, X_2, X_3)$	demand	2SLS
(2.2)	$Y_1 = f(Y_2, X_5, X_6)$	supply	
(3.1)	$Y_3 = f(Y_4, X_1, X_2, X_3)$	demand	2SLS
(3.2)	$Y_3 = f(Y_4, X_7, X_8)$	supply	
(4.1)	$Y_5 = f(Y_6, X_1, X_2, X_3)$	demand	2SLS
(4.2)	$Y_5 = f(Y_6, X_9, X_{10})$	supply	
(5.1)	$Q_{DFHA} = Q_{SFHA} = Z$		
(5.2)	$Q_{DTOTAL} = Q_{DFLB} + Y_1 + Y_3 + Y_5 + Q_{DFHA}$		

where

Q_{DFLB} = Demand for Federal Land Bank loans measured as the annual net change in farm real estate debt owed to Federal Land Banks.

Y_1 = Demand and supply of commercial bank loans measured as the annual net change in farm real estate debt owed to commercial banks.

Y_2 = A proxy for the interest rate paid (received) on commercial bank farm mortgage loans measured as the interest rate on new loans by FLB's.

Y_3 = Demand and supply of life insurance company farm mortgage loans measured as the annual net change in farm real estate debt owed to life insurance companies.

Y_4 = A proxy for the interest rate paid (received) on life insurance company farm mortgage loans measured as the interest rate on new loans by FLB's.

Y_5 = Demand and supply of individual and other loans measured as the net change in farm real estate debt owed to individuals and others.

Y_6 = A proxy for the interest rate paid (received) on individual and other farm mortgage loans measured as the interest rate on new loans by FLB's.

$Q_{DFHA} = Q_{SFHA}$ = Demand and supply of Farmers Home Administration loans measured as the net change in farm real estate debt owed to the Farmers Home Administration.

Q_{DTOTAL} = Aggregate demand for farm mortgage loans measured as the net change in real estate debt owed to all sources.

X_1 = Annual level of capital appreciation, defined as the annual change in farm real estate assets, less capital improvements.

X_2 = Annual net farm plus nonfarm income.

X_3 = Ratio of money balances to gross production expenses expressed as a percentage. Money balances are measured as the stock of demand deposits and currency of the farm sector on hand, January 1.

X_4 = Interest rate on new loans by Federal Land Banks.

X_5 = Spread between the average interest rate on commercial bank farm mortgage loans and the yield on Aaa bonds.

X_6 = Stock of time deposits held at country member banks, January 1.

X_7 = Spread between the average interest rate on life insurance company farm mortgage loans and the yield on industrial bonds.

X_8 = Total annual investments made by life insurance companies.

Table 1.—Regression estimates of net changes in farm real estate debt outstanding for major lending institutions[a]

Equation		R² [b]
(1.1)	$Q_{DFLB} = 280.3 + \underset{(7.0)}{5.05X_1} + \underset{(9.9)^{**}}{19.84X_2} - \underset{(6.7)^{**}}{17.01X_3} - \underset{(64.6)}{3.53X_4}$	0.83
(2.1)	$Y_1 = -16.64 + \underset{(65.6)}{3.35Y_2}$[c] $+ \underset{(5.4)}{7.14X_1} + \underset{(8.4)}{11.29X_2} - \underset{(6.5)}{4.75X_3}$	.64
(2.2)	$Y_1 = -386.2 + \underset{(43.0)}{4.58Y_2} + \underset{(40.0)^{**}}{128.37X_5} + \underset{(0.002)^{**}}{0.009X_6}$	.84
(3.1)	$Y_3 = 2491.2 - \underset{(72.0)^{**}}{337.23Y_4} + \underset{(5.9)}{3.99X_1} + \underset{(9.1)^{**}}{22.28X_2} - \underset{(7.1)^{**}}{36.93X_3}$	.71
(3.2)	$Y_3 = -1632.5 + \underset{(80.4)^{**}}{272.50Y_4} + \underset{(60.0)^{**}}{386.91X_7} + \underset{(0.004)}{0.005X_8}$	.78
(4.1)	$Y_5 = 604.7 - \underset{(139.6)}{17.37Y_6} + \underset{(9.7)^{**}}{20.45X_1} + \underset{(16.2)}{16.09X_2} - \underset{(12.4)^{*}}{20.00X_3}$	.82
(4.2)	$Y_5 = -1637.7 + \underset{(397.9)}{82.20Y_6} + \underset{(79.0)^{**}}{216.47X_9} + \underset{(0.008)}{0.010X_{10}}$	.79

[a] Numbers in parentheses below the regression coefficients are standard errors with * and ** indicating the coefficient is significant at the 10 percent or 5 percent level respectively.

[b] R²'s in the equations estimated by two-stage least squares are presented for the intuitive appeal they may possess, not for hypothesis testing. See Dhrymes (*2*, p. 240-260) for further discussion on this point.

[c] The variable has the theoretically incorrect sign on the regression coefficient.

X_9 = Spread between the average interest rate on individual and other farm mortgage loans and the yield on 3- to 5-year U.S. bonds.

X_{10} = Value of farm real estate assets, January 1.

Z = A predetermined variable which represents congressional appropriations for FHA direct lending.

The model was estimated in linear form by ordinary least squares (OLS) or two-stage least squares (2SLS) when appropriate. Annual data for 1947-69 were used. In equations estimated by two-stage least squares, endogenous variables are designated by a Y, while exogenous variables are designated by an X. In all cases, both supply and demand equations are normalized on the quantity variable rather than on the price variable. Results of the estimations are presented in table 1.

Equation 1.1 represents the demand equation for Federal Land Bank loans. A supply equation was not estimated since this institution is a borrower cooperative and the quantity supplied is primarily determined by the quantity demanded. Results of the statistical estimation indicate that all variables have the expected signs. The regression coefficients for capital appreciation and the rate of interest are not significant at the usually acceptable levels.

Equations 2.1 and 2.2 represent the demand and supply equations respectively for net changes in farm real estate debt held by commercial banks. The two equations represent a simultaneous system and were estimated by two-stage least squares. Both equations are overidentified by the order condition and both satisfy the rank condition for identifiability. Estimation of the demand equation did not result in any statistically significant regression coefficients.[6] For variables X_1 through X_3—demand shifters—all coefficients have the theoretically correct signs, while the coefficient for interest rate is theoretically incorrect. However, one would not reject the hypothesis that the regression coefficient on the interest rate variable was zero.

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[6] The rank condition was evaluated on the basis of the structure of the model prior to estimation. One can also evaluate the rank condition after estimation: "With probability equal to one minus the level of significance of the test the rank condition does not hold" (*2*, p. 295). Using this criterion, the probability that equation 2.2 is not identified by the rank condition is 0.16.

Equation 2.2 represents the supply function for commercial banks. The spread between yields on farm and nonfarm investments is measured by the difference between the average interest rate on commercial bank farm mortgages and the yield on Aaa bonds. Conceptually, the spread between returns on farm mortgages and short-term (less than 1 year) placements may also affect supply. However, preliminary analysis indicated that variables of this nature added virtually nothing to the explanatory power of the equation. For this reason, and to avoid problems of multicollinearity among variables, the spread between returns on farm mortgages and short-term placements was excluded from the supply equation for commercial banks.

Melichar (*6*) has stated that one of the primary determinants of a bank's ability to lend is the level of its deposits. Therefore, time deposits held in country member banks were included as an explanatory variable.[7] As the level of time deposits increases, one would expect investments in farm mortgages to increase. Estimation of equation 2.2 resulted in the theoretically correct signs on all coefficients. Regression coefficients for both the spread between the yield on farm and nonfarm investments and the level of time deposits were statistically significant at the 5 percent level. The regression coefficient for the interest rate variable was insignificant.

Results of equation 2.1 and 2.2 suggest that net changes in farm real estate debt held by commercial banks are more strongly explained by the supply variables tested than the demand variables tested. R^2 of 0.84 for equation 2.2 is substantially above the 0.64 obtained for equation 2.1.

Equations 3.1 and 3.2 represent the demand and supply equations for farm real estate debt held by life insurance companies. The equations represent a simultaneous system. Both equations are overidentified by the order condition, and both satisfy the rank condition. For the demand equation, all regression coefficients have the theoretically correct signs, and all except the coefficient for capital appreciation are significant at the 5 percent level or less. The supply function for life insurance companies is estimated by equation 3.2. The yield differential between farm and nonfarm investments is measured by the spread between the average interest rate on life insurance company farm mortgage loans and the yield on industrial bonds.[8]

The total annual investments of life insurance companies were used to measure the availability of funds. All coefficients have the theoretically correct sign and coefficients for the yield differential and the interest rate are significant at the 5 percent level or less. As with commercial banks, the supply factors tested appear to be more important than demand factors for explaining net changes in real estate debt.

Estimates of the supply and demand equations for farm real estate debt held by individuals and others are presented by equations 4.1 and 4.2 respectively. The equations satisfy the rank and order conditions for identification. For the demand equation, all coefficients have the theoretically correct signs. The coefficient for capital appreciation is significant at the 5 percent level while the coefficient for ratio of money balances to gross production expenses is significant at the 10 percent level. The sign on the regression coefficient for the interest rate is theoretically correct, but one would fail to reject the hypothesis that the coefficient was zero.

Equation 4.2 represents the supply equation for individuals and other. The spread between the average interest rate on farm mortgage loans by individuals and the yield on 3- to 5-year U.S. bonds was used to measure the yield differential between farm and nonfarm investments. The primary source of farm mortgage funds from individuals and other arises out of farmland sales under seller mortgages and land contracts. Therefore the total value of farm real estate was used to measure the potentially available supply of funds from this source. All coefficients have the theoretically correct signs, although the yield differential was the only variable with a coefficient significant at the 5 percent level or less.

Equation 5.1 was not estimated since congressional appropriations are the primary determinant of the quantity of FHA direct loans. Equation 5.2 is an identity equation which merely indicates that aggregate demand is the summation of the demands for farm real estate debt held by the various lending institutions. By using the estimated values for a given institution, one can estimate aggregate demand. For example: $\hat{Q}_{DTOTAL} = \hat{Q}_{DFLB} + \hat{Y}_1 + \hat{Y}_3 + \hat{Y}_5 + Q_{DFHA}$ where

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[7] Several alternative measures of supply availability from commercial banks were also tested. In one run, the level of total reserves of country banks was used instead of time deposits. The resultant regression coefficient had the right sign, but was statistically insignificant. Using the level of time deposits held by the farm sector at commercial banks, rather than the level of time deposits held by all sectors at country member banks gave results very similar to those reported in equation 2.2. Including demand deposits with time deposits did not improve the results.

[8] The spread between returns on farm mortgages and short-term placements was not included for the same reasons cited in the discussion of the supply equation for commercial banks.

^ indicates the value is an estimate. Since the estimate of Y_1 may, for example, overstate the true value of Y_1, while the estimate of Y_3 may understate the true value of Y_3, the error in estimates can be partially or completely offset by aggregation. Thus, in general, the aggregate estimate obtained in this fashion will be better than if no offsetting errors occur. A comparison of residual errors over the time period studied indicated that offsetting errors occurred approximately 50 percent of the time.

Structural Elasticity Estimates

The preceding discussion has focused on the relationships between supply and demand equations for a given institution. One can also compare results across institutions by examining elasticity estimates to determine the responsiveness of supply and demand to changes in selected variables.[9] For commercial banks, the regression coefficient on interest rate in the demand equation (hence the own price elasticity of demand estimate) had the theoretically incorrect sign and was insignificant. The own price elasticity of demand estimates for Federal Land Banks and individuals and other were –0.10 and –0.22 respectively, indicating a very inelastic demand for farm mortgage funds from these sources. The own price elasticity of demand for life insurance company farm mortgage loans, however, was estimated at –8.37, indicating a very elastic demand.

These estimates do not confirm or deny the hypothesis of a highly inelastic demand at the aggregate level, but they suggest that elasticities of demand do vary from one institution to the next. However, due to the low significance levels on regression coefficients, one can place little reliance on the estimated elasticities of demand for Federal Land Banks and individuals and other. Nevertheless, the suggestion remains that elasticities computed at the aggregate level may be of limited value for a given institution concerned with setting its pricing policies or reacting to the policies of other institutions.

Own price elasticity of supply varied substantially from one institution to the next. The own price elasticities of supply estimated were 0.16 for commercial banks, 6.76 for life insurance companies, and 1.05 for individuals and others. However, due to the low significance levels on regression coefficients, one can place little reliance on the estimated elasticities of supply for commercial banks and individuals and other. A perfectly elastic supply was assumed for Federal Land Banks.

All demand equations contained capital appreciation, net farm plus nonfarm income, and the ratio of money balances to gross production expenses. The elasticity estimates for capital appreciation were 0.10, 0.23, 0.09, and 0.24 for the demand equations for Federal Land Banks, commercial banks, life insurance companies, and individuals and other, respectively. These estimates are fairly uniform across all lenders and indicate that a 10 percent increase in the level of capital appreciation would lead to a 1 to 2 percent net increase in real estate debt. But it should be noted that no statistical significance attaches to three of the four regression coefficients upon which the elasticity estimates are based.

The income elasticities of demand were estimated at 2.28, 1.72, 1.64, and 0.85 for life insurance companies, Federal Land Banks, commercial banks, and individuals and other, respectively. These estimates appear to fall into an explainable pattern. In general, life insurance company and Federal Land Bank farm mortgage loans have a much longer maturity than either commercial bank or individual loans.

One possible reason why elasticity estimates are larger for life insurance companies and Federal Land Banks is that as income increases, farm borrowers may become more confident of future income earnings, thereby undertaking loans with a longer maturity which are typically offered by these two institutions. Likewise, as income falls, confidence may decline and loans with a longer maturity will be in less demand than loans with a shorter maturity. Another possible explanation for the relationships among income elasticity estimates is that financial intermediaries (life insurance companies, Federal Land Banks, and commercial banks) may give more emphasis to income in evaluating potential loans than do individuals. Farm borrowers realizing this situation would be more willing to seek loans from financial intermediaries as income increases. Again, it must be noted that only the coefficients for Federal Land Banks and insurance companies were statistically significant.

The elasticity estimates for the ratio of money balances to gross production expenses were –1.88 for Federal Land Banks, –0.88 for commercial banks, –4.80 for life insurance companies, and –1.34 for individuals and other. Three of the four estimates are based upon statistically significant coefficients. Thus, increases in gross production expenses coupled with lower levels of money balances can be an important factor in explaining increases in real estate debt.

Supply shift variables include some measure of the yield differential between farm and nonfarm investments as well as some measure of the availability of funds. The elasticity estimates on the yield differential were 1.42 for life insurance companies, 1.38 for commercial banks, and 0.81 for individuals and other. The relationships among these results are expected since life insurance companies and commercial banks can quite easily transfer funds from one alternative to the next, whereas individuals may need to retire or change occupations to supply funds under a land contract, for example. All three elasticity estimates are derived from statistically significant regression coefficients.

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[9] All elasticity estimates reported here are computed from structural equations and are estimated at the arithmetic mean.

Due to the nature of the variables used in measuring supply availability, caution must be taken in comparing elasticities across institutions. For commercial banks, the elasticity with respect to time deposits was estimated at 2.06. The implication is that as the farm sector increases its holdings of time deposits at commercial banks, the supply of farm mortgage funds forthcoming from banks should increase substantially. For life insurance companies, the estimated elasticity for total investments is 0.54. This implies that life insurance companies tend to increase holdings of farm mortgages about one-half as fast as total investments, other things equal. In recent years, however, "other things" have not been equal. The spread between the yield on farm and nonfarm investments has changed rapidly and this has accounted for significant changes in life insurance company lending to agriculture. The elasticity of real estate value for individuals and other was estimated at 0.30, indicating that the supply of farm mortgage funds from this source does not increase in equal proportion to increases in real estate value.

Interactions Among Lending Institutions

There appear to be at least two forms of simultaneity that could be considered in connection with this study. Previously only the simultaneous determination of supply and demand for a given institution was considered. A second form of simultaneity can result from interactions among lending institutions. The percentage of all farm mortgage loans supplied by Federal Land Banks, life insurance companies, commercial banks, and individuals and other has ranged from 96 to 98 percent over the last 20 years. This suggests that in terms of net changes in debt, the actions (lowering equity requirements, for example) of one lending institution may affect the market share and hence the net change in debt to one or more of the other lending institutions. What is not so clear, however, is the relative importance of the market share factor compared with that of supply and demand changes in determining net changes in farm real estate debt for a given institution.

Several additional systems of simultaneous equations were tested using two-stage least squares. The model presented previously was adapted to include the net change in farm real estate debt for one or more institutions as independent variables. Thus the entire model was simultaneous, rather than just the supply and demand equations for a given institution. Generally speaking, the inclusion of the net change in real estate debt for a given institution as an independent variable resulted in a positive sign on the associated regression coefficient. Frequently the coefficient was insignificant. The results, while not conclusive, do suggest that while competition among institutions may have some effect, expansion or contraction of supply or demand appears to be more important in determining net changes in real estate debt. It should be remembered that net changes in debt were used as the measure of supply and demand. If one measured supply and demand on the basis of gross annual flows, the results could differ.

Summary and Implications

The preceding discussion has focused on the estimates of supply and demand equations for explaining net changes in farm real estate debt. A highly inelastic own price elasticity of demand was obtained for three of four lending institutions, albeit the estimates are based on insignificant regression coefficients. Estimates of own price elasticity of supply indicate an elastic supply for life insurance companies and individuals, but an inelastic supply for commercial banks. Supply from Federal Land Banks was treated as perfectly elastic by assumption. Own price elasticities of supply and demand for farm mortgage funds are key items in determining the expected impact of monetary policy (which affects interest rates) on the level of farm real estate debt in the farm sector. The elasticity estimates presented above suggest that in general, the impact of interest rate changes will vary by lending institution and that the greatest impact may be on supply rather than demand. Further research is needed to make definitive statements on this point.[10]

Estimated elasticities of demand shift variables indicate that net changes in real estate debt are much more sensitive to changes in income than to capital appreciation. These estimates have implications for the effects of Government price support programs on the level of real estate debt. If a support program results in higher income, this may lead to an increase in debt in greater proportion than the increase in income. If the benefits of the support program could be "capitalized" into the value of land with no effect on net income, then the increase in real estate debt would very likely be even greater. However, portions of the increased net income due to a support program may be offset by capitalization of land values, because higher land values can lead to higher total interest payments if land is purchased with borrowed funds, higher rent payments if land is rented, higher property taxes, etc. Therefore, the overall impact of the support program on changes in real estate debt depends in part on the rate of capitalization and the effect of capitalization on net income. In addition, one would want to know the effect, if any, of the support program on money balances and production expenses.

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[10] Among other things, one would want to reexamine the specification of variables and the scope of the model presented here, which is an initial effort.

The spread between yields on farm and nonfarm investments and some measure of available funds were generally found to be important supply-related variables. The fact that commercial banks and life insurance companies respond to yield differential has important implications for the farm sector. To maintain adequate supplies of funds from these sources, farm borrowers will need to compete effectively with nonfarm borrowers. In recent years the spread between the yield on life insurance company farm mortgage loans and nonfarm investments has declined rapidly. The result has been a decline in farm mortgage lending by life insurance companies. If this trend on the yield differential were to be reversed, one might expect life insurance companies to again expand farm mortgage loans, provided adequate funds are available. It was also shown that the supply of farm mortgage funds from commercial banks is very responsive to the level of time deposits. Thus research is needed on the effects of policy variables on the level of time deposits. Research of this nature will lead to a better understanding of the supply response of commercial banks.

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AGRICULTURAL ECONOMICS RESEARCH VOL. 24, NO. 1, JANUARY 1972

Economic Projections Using a Behavioral Model

By Richard J. Crom

A recently published model of the livestock-meat economy is used to illustrate modifications that permit us to obtain a reasonable and consistent set of projected values to 1980. Economic theory and an understanding of the industry were used to introduce a set of assumptions about institutional change and human behavior. The projected values serve as a basis for comparison with alternative projections resulting from changes made in the model to represent different policies or management decisions.

Key words: Beef; methodology; pork; projection; simulation models.

In recent years, economists have developed quantitative models of entire industries as more sophisticated computer software became available. The computer's ability to store and retrieve data generated from successive sequential solutions of relationships in the model provides means for projecting the model into the future. The projection can be made for a considerable length of time, since the model generates values of its own endogenous input variables, if projected values of exogenous variables are supplied.

Various methods of determining more precise and more reliable measures of behavioral and technical coefficients have been developed with the goal of achieving more reliable projections. But projections from all models necessarily based on historical relationships are fallible due to their common underlying assumptions and their mathematical derivation. The error term associated with functional derivations, usually regarded as a result of random forces in the historical period, may have profound effects on projections when the estimated value it affects is used as sequential input. Once an error is initiated, a cumulative error "buildup" is introduced into the projection period. Furthermore, the constant term of the function will eventually be of insufficient magnitude to maintain proper relationships between the estimated and the explanatory variables. As a result, estimates will be too large (or too small).

While the former problem is serious, its consequences are not as unresolvable as other assumptions inherent in the model. Models which quantify the economic structure of a sector of the economy describe that economic structure which evolves from the institutional structure and human behavior of that period. Thus, any projection of such a model implies that the institutional structure and human behavior which existed in the past will be invariant in the future. Such an assumption is naive!

Projection of a model as developed from historical data does maintain scientific objectivity and is a useful first step. However, the probability of obtaining unrealistic values after several time periods is high, even if modifications were included in the original model to negate error buildup. Continued use of behavioral or technical relationships containing trend terms may soon yield very large or very small values of the variables they predict. In addition, unique situations which bring about expected changes in behavior may arise which were not encountered during the historical period. Since we have no specific observations from the past to indicate appropriate changes in the structure of the model, we are left with the choice either of accepting the projection as generated by the model or of modifying the model to yield projections in line with reasonable expectations. The latter projections may well be more useful as decision criteria if all assumptions about structural changes are clearly identified. While the latter approach involves informed judgment, the former may leave the economist with a set of projections no one believes.

Editor's Note: A technical bulletin published by USDA in September 1970 contained a simulation of the U.S. beef and pork economy for 1955-70. Recently, the model was used to evaluate the effect of several beef import levels on the domestic livestock industry (U.S. Dept. Agr., unpublished manuscript). This exercise required modification of the original model as published, to obtain the set of projected values used as a basis for comparison of the alternative import levels. The accuracy of the model for short-term prediction has not been tested. The present article shows the changes that were made in assumptions, the reasons for the changes, and the improvement that was obtained in results. This article is intended to stimulate thinking among researchers about some basic methodological issues that economic projections involve.

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Modification of a formal economic model to obtain a set of projected values which are consistent and reasonable introduces an element of art. The economist's goal is to obtain a consistent and viable set of projected values with a minimum of structural change. It involves selection and implementation of a further set of assumptions about economic behavior and institutional change which constrain the model in order to produce an acceptable set of projected values. It involves the use of economic theory, an understanding of the industry, and a good bit of common sense. The projected values that result from an initial experiment on the model serve as a set of base values for comparison with sets of projected values obtained from further experimentation (simulation).

While developing a recursive model of the beef and pork sectors,[1] an attempt was made to take account specifically of error terms in functional relations usually regarded as random and to introduce modification in behavioral reactions to unusual economic situations in a very elementary sense. These modifications in the model, referred to as "operating rules," are discussed fully in the publication cited. They were made while developing the model over the historical period in anticipation of achieving a more precise and realistic set of variables in the projection period. Operating rules were of three general types. One type involved introducing a change into the relationship when one of the explanatory variables exceeded a certain value or fell below a value usually outside of the range of the data. Another type of rule included a change in a relationship when certain variables not in the function obtained extreme values. A third type of operating rule involved a change in a behavioral relation when a variable changed by an unusually large amount from its previous value. Examples of these operating rules are presented in the order described above.

In the relationship estimating commercial hog slaughter, hog slaughter was reduced 54 million pounds for each $1 increase in hog price the previous quarter. An increase (decrease) in the lag price induces producers to hold (sell) more breeding stock and thereby reduce (increase) their marketings of slaughter hogs. Observation of historical data indicated that less breeding stock than usual was marketed when the lag price fell below $13 per hundredweight. This is plausible since it is reasonable for producers to expect more favorable prices to follow extremely low prices. Thus an operating rule was introduced to reduce the coefficient of lag hog price from (−54) to (−30) when the lag price fell below $13.

Hog prices usually did not affect the number of cattle placed on feed. The latter are a function of the supply of feeders available (as indicated by the January 1 inventory) and the beef-corn ratio. However, extreme values of hog prices are likely to cause some "switchover" between cattle and hog feeding. In the second quarter, the estimate of placements of cattle on feed was reduced 4 percent when the second-quarter hog price exceeded $23.50 per hundredweight. This operating rule was effective in 1966 and 1969 when high hog prices probably induced some farmer-feeders to increase hog production at the expense of cattle feeding.

Finally, a sharp increase in the value of a variable used in a behavioral relation may have more impact than an orderly change in the value of the variable over time. Sows farrowing usually were increased (decreased) for each $1 rise (fall) in the price of hogs two quarters earlier. However, observation of the data indicated that a substantial drop ($7) from the year-earlier price initiated an additional 14 percent cut in sows farrowing.

During the development of the model, a total of 126 operating rules were introduced over the 60 calendar quarters (1955-70) to obtain a more precise reproduction of the variables. They were employed 221 times to modify 1,620 values of variables simulated by the system. Behavioral relationships were used to simulate 1,125 values of variables during this period; identities were used to simulate 795 values of variables. Each behavioral relation which simulated quarterly values was used 60 times; relationships simulating annual values were used 15 times. The greatest combination of operating rules and explanatory variables used in any one behavioral relationship was 26 for the quarterly relationships and eight for the annual relationships.

Use of these modifications in initial situations improved the validation of the model substantially. In the case of the January 1 beef cow inventory, the prime determinant of growth in the cattle sector, the initial operation of the model was "on track" compared to the historical data for 2 years; but this was followed by four overestimates, two underestimates, and another expansion phase (see fig. 1).[2] The validation run reproduced the beef cow inventory with minor errors. The distribution of errors in per capita supplies and prices is shown for the initial run and validation run for the comparable 52-quarter period 1955-68 in tables 1 and 2. In general, the recursive system could tolerate an error in the estimation of per capita supply of about 0.5 pound or an error of $1.50 to $2 in the price of live steers.

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[1] R. J. Crom, A Dynamic Price-Output Model of the Beef and Pork Sectors, U.S. Dept. Agr., Tech. Bul. 1426, Sept. 1970.

[2] The initial run was made to June 30, 1968, while the validation run continued to June 30, 1970.

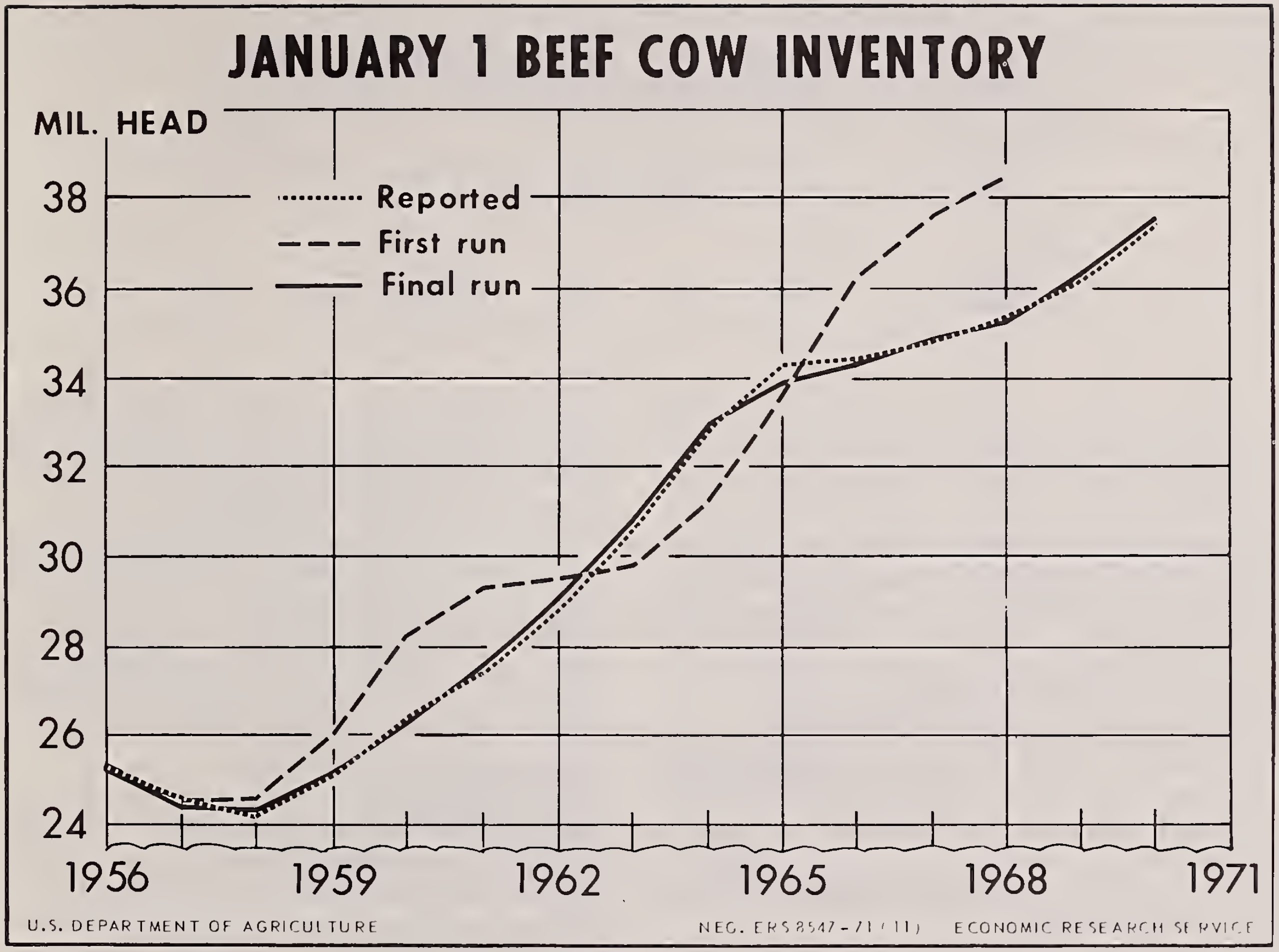

Figure 1

Table 1.—Distribution of per capita supply errors in validation period, July 1955 to June 1968

Item	Range in errors (lbs.)							
	0.0	0.1-0.4	0.5-0.8	0.9-1.2	1.3-1.6	1.7-2.0	2.1-3.0	3.1-7.0
Per capita fed beef consumption:								
First run	1	17	12	16	3	3	0	0
Validation run . .	9	40	3	0	0	0	0	0
Per capita nonfed beef supply:								
First run	3	17	14	7	5	1	2	3
Validation run. .	9	44	9	0	0	0	0	0
Per capita pork supply:								
First run	1	15	6	9	9	5	7	0
Validation run . .	8	36	7	1	0	0	0	0

Table 2.—Distribution of pricing errors in validation period, July 1955 to June 1968

Item	Range in errors ($/cwt.)					
	0-.50	.51-1.00	1.01-2.00	2.01-3.00	3.01-4.00	4.01-5.00
Choice Steer Price:						
First run	12	10	12	5	7	6
Validation run	31	14	7	0	0	0
Hog price:						
First run	3	13	10	9	11	6
Validation run	30	15	7	0	0	0

When making a prognosis of economic activity, projection with a dynamic behavioral model provides useful information, since it portrays the temporal interactions among the many variables of the industry. Hypotheses about the results of a change in the structure portrayed by the model, in the exogenous variables, or in the initial conditions can be tested by initiating these changes, simulating their results, and comparing these results with the base projection of the model (i.e., a projection without the hypothethized change).

Recently, the quarterly price-output model of the beef and pork sectors was projected to 1980 based on data and conditions known for July 1, 1970. The modifying assumptions introduced into this model to obtain the base projection are used as examples of further modification of a model to obtain a more useful set of projected values.[3]

Initial projection to 1980 of the model as validated through July 1, 1970, yielded a set of quantity values indicating a growth rate considerably greater than would be expected by knowledgeable people in the industry. Prices remained correspondingly low. The broken lines in figure 2 indicate initial values simulated by the model for three selected variables. (Recall values of 26 variables are simulated each quarter with an additional four simulated as of each January 1.) Careful examination of the model indicated the need for replacing four basic functions and their 28 associated operating rules. Critical values were adjusted upward in another 18 operating rules to keep up with the general increase in price levels.

In two cases, the functional estimates were replaced with constant values. The average weight of nonfed cattle at marketing was considered a function of time and a seasonal factor in the original model. The average weights of nonfed cattle were held constant during the projection period at their 1970 levels, since continued operation of the trend term would have yielded nonfed weights heavier than those of fed cattle.

Beef exports, a relatively minor item, were held constant during the projection period near the modal values of the late 1960's. Thus, they became an exogenous variable since exports are now essentially used to satisfy demands of U.S. citizens abroad. The original function did not perform satisfactorily and the relative unimportance of the variable did not warrant development of a new relationship.

One important type of change in the model for the projection period was the modification or reestimation of behavioral relationships. Since many of the operating rules developed over the historical period were specifically associated with a particular function, introduction of a replacement function necessitated removal of some operating rules. And the need for new operating rules to further modify the replacement functions became apparent as the projection progressed.

The beef import function was reestimated from 1963-70 data using the same explanatory variables. The coefficients of this new function were not biased by the low values of observations in the 1950's and early 1960's. Thus, operating rules initiated during the latter part of the validation period in the original model were deleted. They were replaced with operating rules which held the resulting annual average beef imports between 6.5 and 7.5 percent of domestic beef production after allowing for seasonal variation. These constraints approximated the current levels of imports under existing quotas. While the quota limits imports, exporting countries hold their shipments near this maximum. Unless the existing regulations are repealed, it appears reasonable to expect similar behavior throughout the projection period as long as the United States maintains a favorable market for foreign suppliers.

The revised function for estimating beef imports based on 1963-70 data is:

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[3] The model was programmed to start as of July 1, 1955, and no other date. Therefore, to commence operating the model as of any other July 1, several technical programming changes were necessary. Specific details of these technical changes will be furnished interested readers upon request along with all other modifications deemed necessary for the projection period.

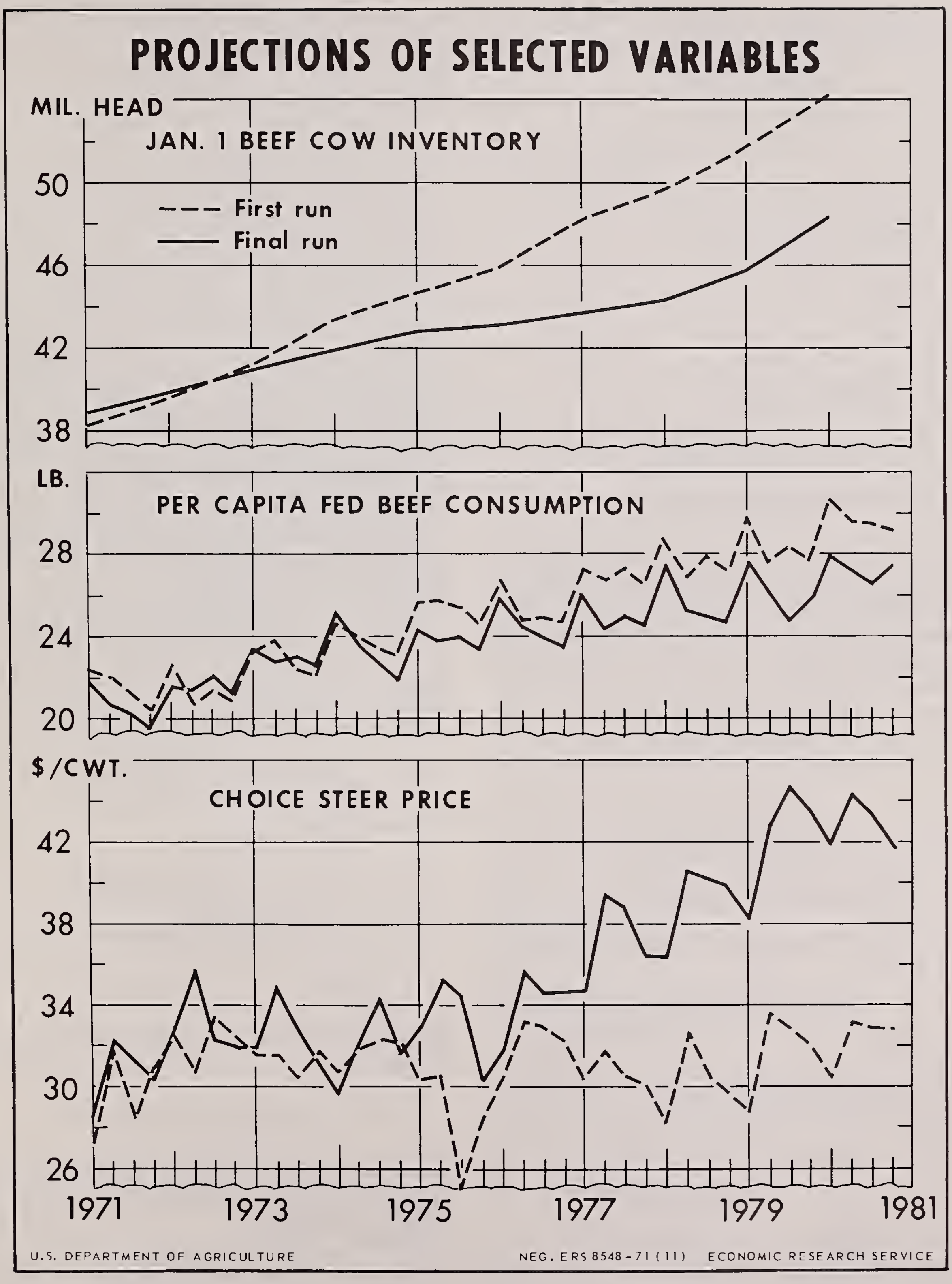
PROJECTIONS OF SELECTED VARIABLES
MIL. HEAD
JAN. 1 BEEF COW INVENTORY
First run
Final run
50
46
42
38
LB.
PER CAPITA FED BEEF CONSUMPTION
28
24
20
$/CWT.
CHOICE STEER PRICE
42
38
34
30
26
1971
1973
1975
1977
1979
1981
U.S. DEPARTMENT OF AGRICULTURE
NEG. ERS 8548-71 (11)
ECONOMIC RESEARCH SERVICE

Figure 2

$$\begin{array}{llll} Y_{jt} = 1450.76 + 4.194\,X_1 & -\ 123.54\,X_2 & +\ 83.5\,W_1 \\ \qquad\quad (2.92)\ (2.92) & \qquad (28.8) & \quad (33.1) \end{array}$$

$$\begin{array}{ll} -\ 40.5W_2 & +\ 45.8\,W_3 \\ \quad (26.6) & \quad (40.4) \end{array}$$

$$R_2 = 0.88 \qquad d = 1.99$$

Y_{jt} = quarterly imports of beef in millions of pounds, carcass weight,

$X_1 = (PR_{j\text{-}1,t} + PR_{j\text{-}2,t})/2.0$,

$X_2 = (PN_{j\text{-}1,t} + PN_{j\text{-}2,t})/2.0$,

W_{jt} = quarterly 0-1 variables,

PR_{jt} = wholesale price of cow beef at New York,

PN_{jt} = per capita supply of nonfed beef.

Thus, beef imports increase when lagged domestic wholesale prices increase, decrease when lagged per capita supplies increase, and vary seasonally. These explanatory variables are the same variables used in the earlier model. However, each quarter's estimate is constrained by two tests:

$$\text{If } (\hat{Y}_{jt}) \geqslant U,\ \hat{Y}_{jt} \equiv U,$$

$$\text{if } (\hat{Y}_{jt}) \leqslant L,\ \hat{Y}_{jt} \equiv L,$$

$$\text{if } (\hat{Y}_{jt}) \overset{U}{\underset{L}{\lesseqgtr}},\ \hat{Y}_{jt} \equiv \hat{Y}_{jt}.$$

Y_{jt} = quarterly estimate of beef imports,

$U = (B_j)$ x (all domestic beef production) = upper limit,

$L = (C_j)$ x (all domestic beef production) = lower limit.

The quarterly values of B_j and C_j are:[4]

Quarter	B_j	C_j
First	0.063	0.050
Second.	.069	.055
Third	.099	.080
Fourth	.069	.055

They allow usual seasonal variation around the 7.5 percent annual maximum or the 6.5 percent annual minimum limits. The functional estimate is used if it falls within these seasonally adjusted limits.

The demand equations in the original model used to obtain wholesale prices for Choice grade carcass beef, utility cow beef, and wholesale pork products contained a per capita personal disposal income variable (fitted in deviation from trend form) and a trend term. The trend term represented long-run shifts in consumer tastes and other secular factors including the trend in personal income. This statistical separation of the two variables overcame the multicollinearity problem of the historical period. But it introduces a fixed relationship between income and trend in the future. The projected income series showed a substantial sharper increase in income from 1964 through 1980 than in the base period. This new trend was removed from the income variable, and the coefficients in the three demand equations were adjusted correspondingly.

In the model developed from historical data, the estimates for the wholesale price of Choice 600-700-pound steer carcasses was:

$$PW_{jt} = A + BZ_{jt} + 0.02253\ Y_{jt} + 0.1106\ T$$

where

PW = wholesale price of Choice beef carcasses,

A = constant (= 71.36 in 3d quarter),

Z = quantity variables,

B = coefficients of quantity variables,

Y = per capita disposable income,

T = time.

The trend in income, which has been removed for 1955-66, was

$$Yjt = 1613.0 + 17.94\ T.$$

The upward trend in per capita disposable income changed in 1964. The trend in income, an exogenous variable, for 1964-80 is

$$Yjt = 300 + 49.46\ T.$$

This new trend was incorporated into the demand equation. Accordingly, the estimator for the wholesale price of Choice grade beef now becomes

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[4] These coefficients of seasonal adjustment were derived through multiplication of the annual coefficient by the historical seasonal index. For example, $B_1 = (0.075) \times (0.84) = 0.063$.

$$PW_{jt} = 71.36 + BZ_{jt} + 0.02253\,[Y - (300 + 49.46\,T)] + 0.1106\,T.$$

This reduces to

$$PW_{jt} = 64.6 + BZ_{jt} + 0.02253\,Y_{jt} - 1.0037\,T.$$

Since the trend component of income is much greater, both the constant of the function and the trend coefficient are lowered to reduce the effects of the new trend in income and thereby maintain the same relationship between the income and trend variables that existed in 1955-66.

Initial projections of the model indicated the need for reduction in the slope of the own price-quantity coefficient, as the sum of per capita supplies of all beef and pork exceeded 45.0 pounds per quarter (seasonally adjusted). Accordingly, the own price-quantity coefficients were reduced 10 percent when the sum of per capita supplies exceeded the turning point indicated by the initial projections. These operating rules introduce a "kink" into the own price-quantity linear demand plane, thereby serving as an approximation of the curvilinear relation suggested by inspection of initial projected values. The adjustment in the original slope coefficient in the demand equation for wholesale pork serves as an example. The form of the original wholesale price estimator was:

$$PW_{jt} = A - 3.3264\,PCPS_{jt} + bZ_{jt}$$

where

PW_{jt} = wholesale price of pork,

$PCPS$ = per capita pork supply,

Z_{jt} = all other variables.

In the projection model, the following addition was made in the second quarter:

$$\text{If } (PCFBC_{jt} + PNFBS_{jt} + PCPS_{jt}) > 43.0$$

$$PW_{jt} = A - 3.0\,PCPS_{jt} + bZ_{jt}$$

when $PCFBC + PNFBS$ = total per capita beef supply.

The values of coefficients specifying producer response to the lagged feeder cattle prices in the relationships specifying January 1 inventories of beef calves and beef heifers, and annual commercial slaughter of beef cows, were reduced when the feeder price exceeded $36 per hundredweight. This level of feeder cattle prices was not attained in the historical period, therefore this modification was not needed when developing and validating the model. As initial projections indicated a rather rapid increase in beef cow inventories when average feeder prices exceeded $36, such a limit appeared necessary. This modification is similar to the demand adjustment; it involved reduction of supply response at extreme values of price variables. For example, the original supply coefficient associated with feeder price (+121.2) in the estimation of January 1 beef calf inventories was reduced to (+111.2) when the feeder price exceeded $36.

A final type of adjustment was necessary because the model was developed using current-dollar prices. While use of constant dollars has substantial merit, no single index is appropriate as a deflator of livestock and meat prices. As the projection of the model progressed, critical values of variables signaling use of operating rules changed with the inflation built into this current-dollar system. For example, the original model contained an operating rule which specified an increase in placements of cattle on feed in the summer quarter if the Choice steer price exceeded $30 in both the second and third quarters. While attainment of this value for two consecutive quarters was rather unusual in 1955-70, it became a more usual level of price during the projection period. Initial projections of the model indicated that an increase in this critical test value to $33 would correct for this change in the price level. Seventeen similar increases in critical values were introduced for the projection period.

Modification of the model resulted in a final set of projected values (see solid lines in fig. 2) where the per capita supply of beef was 20.6 pounds below the initial estimate, and the January 1 beef cow inventory was 6 million head below the initial estimate. Obviously, prices were substantially higher in the latter years. However, Choice steer prices above $40 in current dollars cannot be deemed unlikely by 1980.

These final values achieved through modification of the behavioral model portray a reasonable rate of growth in the domestic livestock industry over the next decade. They are now useful as a basis of comparison for values of the same variables which portray simulated changes in the structure of the industry, changes in policy, or changes in exogenous influence.

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[5] After obtaining a reasonable set of projected values, the model was used to simulate prices and production of cattle and hogs under five alternative policies for regulating beef imports coming into the United States (A. A. Duymovic, R. J. Crom, and J. D. Sullivan, Effects of Alternative Beef Import Policies on the Beef and Pork Sectors, U.S. Dept. Agr., unpublished manuscript).

Conversational Activity and the Quality of Information From Interviews for Obtaining Farm Facts

By Charles H. Proctor and Bill Stines

It might be expected that a more active conversation between enumerator and respondent would provide better data in an interview. Such an effect had been reported for health interviewing. However, it was not discovered in farm interviewing in the survey analyzed in this paper. There is probably an effect on the quality of information from an active conversation interaction but it is likely to be a complex one that requires in-depth study to describe.

Key words: Interviewing; respondent reactions; conversational activity; data quality.

A recent study of response errors in reporting health conditions by household interviewing suggested that a more active conversation may improve the quality of health information being recorded during the interview.[1] In earlier studies of response errors in obtaining farm facts[2] we had noted some effects of conversational style on response errors, but we had not looked specifically at the amount of conversation as a possible explanation of response errors. This we will do in the present report.

The source of the data was an experiment-in-a-survey done in North Carolina in 1962. A Statewide sample of farm tracts parallel to that for the December Enumerative Survey[3] was selected. Six teams of enumerators, two in each of three geographic strata of the State, were each assigned to collect data on 24 farm tracts. The enumerators all used the standard questionnaire form but were instructed to vary the asking of the questions in accord with a 2^3 factorial design. The factors were choice of respondent (first or best), approach (friendly or official), and location (house or field). In the friendly approach, the enumerator looked at the respondent's eyes while asking the questions and down at his papers while the respondent answered. This was reversed under the official approach. In the friendly approach, the enumerator moved closer or stood beside the respondent, but stayed farther away and faced him in the official approach. Extra topics of conversation were discouraged in the official approach but pursued more naturally under the friendly approach.

The eight treatment combinations were assigned at random to the 24 farm tracts in each enumerator's workload. For one of the teams, the followup enumerator's entire set of questionnaires was lost; and for another team, there were so few tracts with crop entries (only nine of 24 tracts) that five and sometimes only four teams have been included in the following analyses.

With the aid of an instruction booklet and 4 days of training, each enumerator was prepared to use all of the experimental variations. Likewise, the observers were trained in scoring utterances, keeping time on various operations, and coding other aspects of the content of the interviews.

After the questionnaire form had been completed, the respondent was told that a supervisory enumerator would soon come by to ask the same questions again. Within a week a followup enumeration was done, and the differences in the two reports were used to measure response error. Incidentally, there was widespread acceptance by respondents of the followup enumeration. We feel that the survey's concern with accuracy in reporting, as explained by the enumerators, was understood and appreciated by the farmers.

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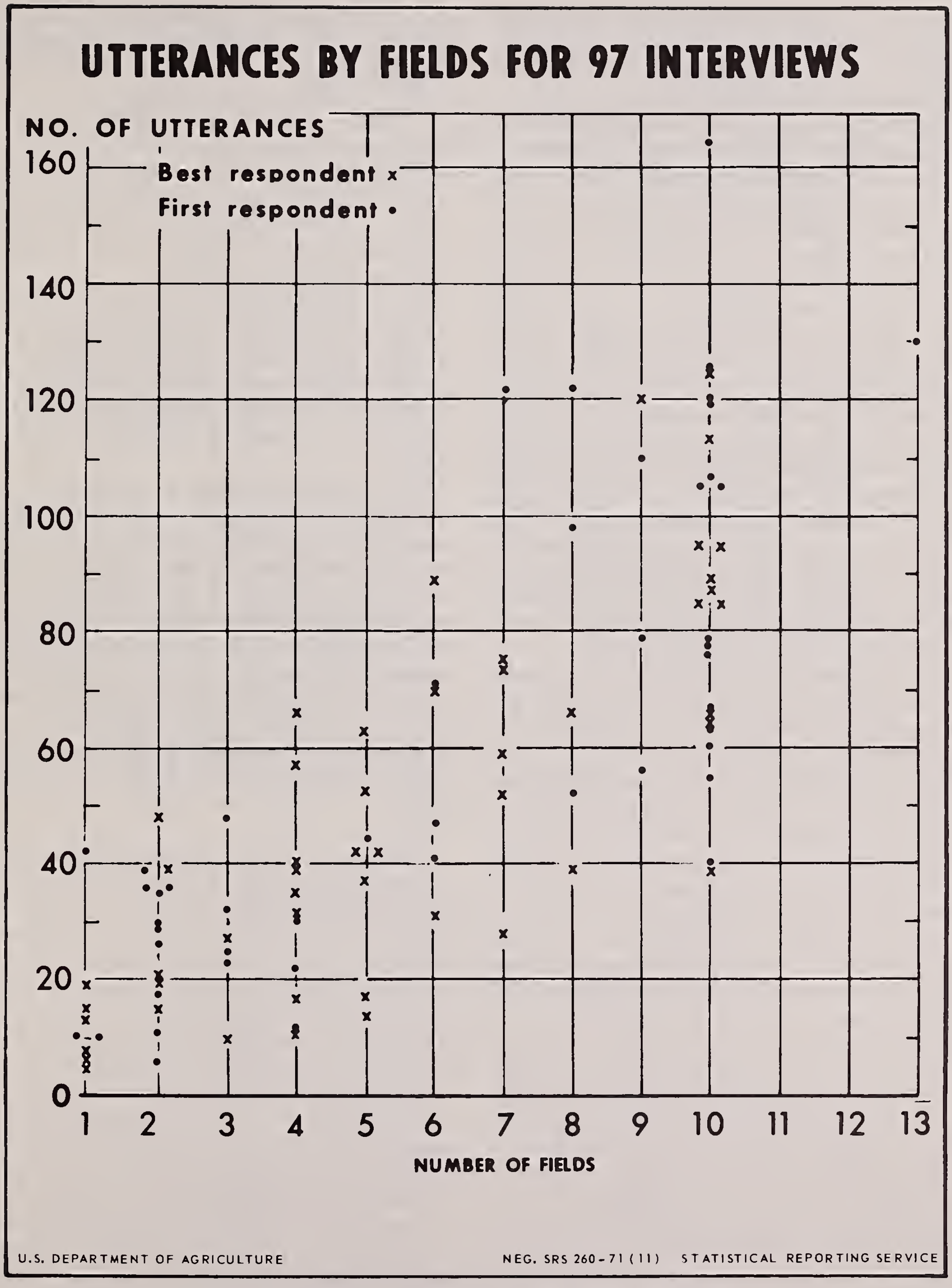
[1] C. F. Cannell, F. J. Fowler, and K. H. Marquis, "The influence of interviewer and respondent psychological and behavioral variables on the reporting in household interviewers," Vital and Health Statis., Natl. Ctr. for Health Statis., PHS Pub. No. 1000, Ser. 2, No. 26, Washington, D.C., Mar. 1968.

[2] C. H. Proctor and Bill Stines, "An experimental survey to study response errors in agricultural enumerative surveys," Prog. Rpt. 34, Inst. Statis., N.C. State Univ., Raleigh, N.C., 1963. C. H. Proctor, "Variations in response errors induced by changing instructions to enumerators," Proc. Soc. Statis. Sec. Amer. Statis. Assoc., p. 51-55, 1965.

[3] These enumerative surveys are conducted twice yearly by the Statistical Reporting Service of USDA with State cooperation.


UTTERANCES BY FIELDS FOR 97 INTERVIEWS
NO. OF UTTERANCES
Best respondent x
First respondent •
0
20
40
60
80
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120
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1
2
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NUMBER OF FIELDS
U.S. DEPARTMENT OF AGRICULTURE
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STATISTICAL REPORTING SERVICE

Figure 1

From all the items of information on the questionnaire form, the present study focuses on acreages reported for three classes of land use: Crops, hay and other pasture, and other land such as woods or houselot. The absolute differences between acreages reported on the initial and on the followup interview were added and divided by the total of all acreage reported. This produced the percent discrepancy scores that constitute the dependent variable of the study. Tracts where no acreages were reported in any of the three categories were not included in the analyses.

Once the enumerator and respondent were launched into the question-and-answer pattern required by the questionnaire, the observer tallied each utterance. An utterance is defined as "a stretch of talk, by one person, before and after which there is silence on the part of the person." The total number of utterances of both enumerator and respondent for the crops, hay and other pasture, and other land questions were found to be proportional to the number of fields in the tract. The relationship is shown in figure 1. Each additional field seemed to bring forth about 10 additional utterances. Therefore, we took the ratio of utterances per field as a standardized measure of the amount of conversation. This variable then became the independent one.

The "best" instruction for the choice of respondent almost invariably led to the farm operator, while the "first" instruction sometimes led the enumerator to conduct the interview with a son, a housewife, or a grandfather. Unfortunately, our reporting forms did not include the name nor status of the respondent. This was an unintentional mistake that caused the loss of useful information. Thus in the following analyses we have separated the data into two parts, by respondent instruction, and treated them separately.

Part of the calculation was done using a multiple regression program[4] in which the team and treatment effects were represented by dummy variables. After removing the team and treatment main effects, the regression coefficient of discrepancy score on the utterance ratio was .175 with a standard error of .451 for the 50 interviews done under the "best" instruction and .131 ± .319 for the 46 interviews done under the "first" instruction. In light of their similarity, pooling the two estimates would appear to be a reasonable procedure, and it yields .153 ± .175. The coefficient .153 is interpreted as an increase of .15 of a discrepancy score per added utterance per field. Thus there is no evidence of an effect such as was reported for the health interviews. In fact, if higher levels of conversation had reduced response errors, the sign of the regression coefficient would have been negative.

To examine the effect of the treatments, the nine observations from team 2 were discarded. Then it was found that the numbers of observations in the 32 cells (4 teams by 8 treatment combinations) were sufficiently similar to do an unweighted means analysis of variance. The means are shown in table 1 and the analysis of variance computations in table 2.

When the enumerator was instructed to collect data from the first person he found, the friendly approach produced considerably more high-discrepancy scores than the official. For this group of interviews, table 2 shows that the team-by-treatment interaction was similar enough to the within-cell variability to pool error sources.

For interviews done under the instruction to interview the best respondent, both of the main effects were apparently present. That is, interviews done in the fields had lower discrepancies than those done near the house, and interviews done under the official approach had lower discrepancies than when using a friendly approach. For these interviews, there was some team-by-treatment interaction that gave us pause before pooling the mean squares. We decided, however, that the enumerator of team 3 was responsible for the interaction and that for generalizing to enumerators more like those of teams 1, 4, and 5 it would be correct to use, as a compromise procedure, the pooled mean square as the error mean square.

Team 3 showed an almost contrary pattern of having a relatively high level of discrepancies under the combined friendly with fields instruction. The enumerator for team 3 would be judged as more of the caliber of a supervisory enumerator, while those of the other teams were more like the usual survey enumerator. It seems quite likely that the team 3 enumerator would be more uncomfortable interviewing under the friendly instruction and this could cause the discrepancy score to rise.

The salutary effect on discrepancy scores of the official approach, in the case of the first respondents, is quite likely due to its encouraging whoever was being bombarded with questions to call for the farm operator. As was confessed earlier, we failed to record who was the respondent and thus we can't verify this suspicion. The enumerator of team 3 again shows a somewhat different pattern of effects in that his "friendly" interviews had fairly low discrepancies. This lends some support to our belief that his natural style was "official" even when under the friendly instruction.

Each enumerator was carrying an aerial photo of the

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[4] The program, called Statistical Analysis System, was developed by A. J. Barr and J. H. Goodnight at North Carolina State University and the computations were done at the Triangle Universities Computing Center with support from a National Science Foundation Grant.

Table 1.—Discrepancy scores and means by enumerator teams and treatments

Enumerator team	First respondent				Best respondent			
	Fields		House		Fields		House	
	Official	Friendly	Official	Friendly	Official	Friendly	Official	Friendly
1.	0.0	0.0	1.1	0.0	19.7	0.0	33.3	21.0
	---	26.5	0.0	44.2	21.0	0.0	6.7	0.0
	---	4.0	0.0	6.1	---	2.3	---	8.1
Mean . .	0.00	10.17	.37	16.77	20.35	.77	20.00	9.70
3.	0.0	2.2	28.6	0.0	0.0	0.0	10.0	.7
	6.7	10.2	1.5	0.0	0.0	32.0	0.0	14.0
	17.4	6.2	0.0	---	4.9	---	6.2	1.2
Mean . .	8.03	6.20	10.03	0.00	1.63	16.00	5.40	5.30
4.	5.3	12.0	0.0	21.8	0.0	1.8	49.7	25.4
	2.5	17.3	0.0	30.8	32.2	.2	29.1	6.4
	---	---	16.7	19.8	0.0	.9	34.0	5.0
Mean . .	3.90	14.70	5.57	24.13	10.73	.97	37.60	12.27
5.	13.1	28.3	2.6	9.8	15.3	0.0	24.6	0.0
	.5	2.6	7.4	17.3	13.0	2.7	9.4	8.9
	10.7	27.6	0.0	---	0.0	4.2	48.4	31.9
Mean . .	8.10	19.50	3.33	13.55	9.43	2.30	27.57	13.60
Unweighted mean. .	5.01	12.64	4.83	13.61	10.54	5.01	22.64	10.22

Table 2.—Analysis of variance for the unweighted means of table 1

Source	First respondent			Best respondent		
	DF	MS	F	DF	MS	F
Teams	3	36.38		3	50.20	
Location	1	.62	0.01	1	299.81	[1]5.17
Approach	1	269.70	[1]5.60	1	322.20	[1]5.55
L x A	1	1.33	.03	1	47.61	.82
Team x Trt. . . .	9	43.32		9	86.79	
Within	26	49.77		29	49.09	
Pooled error . . .	35	48.11		38	58.02	

[1] Since $F_{.025}(1, 40) = 5.42$, all three F values have a significance probability of about .025. The positive skewness of the scores suggests caution in interpreting this probability too exactly.

farmer's fields, and he referred to it during the interview. Even so, the instruction for going into the fields seems to improve the data. We suspect from our own experiences, as well as from the data, that most of this improvement is in a better statement of woodland than of cropland acreages. If this is the case, then it may well not be worth while for the enumerators to make it a practice to go into the fields, since the aerial photo can be and is planimetered in the office to yield more reliable acreages of woodland and at much less cost.

The finding of superiority for the official approach is somewhat at variance with the longstanding admonitions (possibly originating within USDA itself) to enumerators to get and hold rapport with the respondent. The instructions in this study to the enumerator for attaining the friendly, as distinct from the official, approach dealt with surface behavior, namely eye contact, distance and orientation of the body, and extra topics of conversation, and not with "feelings." It would seem reasonable that, even though for the measurement of attitudes or opinions a more friendly and equalitarian atmosphere may reduce response errors, for the recording of facts the more impersonal, official approach is to be preferred.

The central negative finding was that more conversation was not associated with a reduction in discrepancy scores. This does not, in itself, contradict the experiences with health interviews. It suggests that recording farm facts such as acreages is quite a distinct task from reporting health information such as episodes of sickness. Then too, the presence of a positive relationship in our data may be due to the tendency to talk a bit longer in those cases where doubt arises out of the intrinsic difficulty of knowing boundaries. This sort of reverse causality does not preclude the possibility that including probes in the questionnaire, or some other techniques for increasing the volume of conversation, might reduce response errors.

BOOK REVIEWS

Agricultural Development in India's Districts

By Dorris D. Brown. Harvard University Press, Cambridge. 169 pages. 1971. $10.

The Center for International Affairs at Harvard University sponsored this study of India's Intensive Agricultural Districts Program (IADP, Package Program). Results of the first 6 years of the program receive the major emphasis. Organization and operation of the program are described against a background of previous agricultural development efforts in India, the concurrent performance of the Community Development program which continued in the non-IADP districts, the extent to which the original IADP plan was implemented, and the ex post evidence as to the validity of the original plan.

IADP was planned in 1959-60 by an Agricultural Production Team composed of U.S. and Indian agricultural experts. The major premise of the operation was that the selection of the most promising areas for rice and wheat production, and the concentration of development efforts in those areas, would be the most effective way of increasing food production in the Third Plan period (1962-66). "In general, the [Team's] report suggested that prospects were favorable and that sufficient technology was available for an immediate and rapid increase in production if the recommended actions were taken."

As it turned out, the available technology was not as adequate as it should have been. In translating the plan into action, moreover, not all the recommendations were fully implemented. Some would have required changes in government administrative structure, particularly at the district level, that proved as resistant to change as the assumed traditionality of the peasants. Other recommendations that were watered down or ignored in execution were the use of individual "whole farm" plans, provision of price assurance and marketing agreements, and technical assistance for improved water and land utilization.

Apart from the belief in the adequacy of available technology, it was assumed that the weak link in the process of agricultural development was the cultivator. "He was considered ignorant, illiterate, unschooled and unproductive, traditional and conservative, and unprepared to change his methods of farming. Land owners, money lenders, and traders in agricultural commodities were considered antisocial and severe exploiters of cultivators and low income consumers." It was thought that IADP would overcome these deficiencies more effectively than was possible in the Community Development program. IADP would focus more directly on food production. It would use twice as many agricultural technicians as were used in Community Development, make available increased supplies of essential inputs, principally fertilizers, and strengthen and redirect public and cooperative institutions related to agriculture. Apart from its demonstration effect, the IADP would be intrinsically important because it would serve 2.9 million cultivators operating over 20 million acres of cropland.

Brown evaluates IADP results in terms of impact on agricultural production, and impact on institutions and policies. The latter turns out to have been the more significant. Production results were generally not significantly better than in non-IADP districts. Johnson and Malone, with selected data, come to a more optimistic conclusion (this journal, April 1971), but it is difficult to brush aside Brown's comprehensive evidence. He concludes: "Only 3 of the 15 IADP districts reported significantly higher rates of change in output and yield for food grains during the IADP years when compared with their record during the previous five years. Only 2 IADP districts reported significantly higher changes in output of food grains than did bordering districts." And, again, "The IADP record was no better and no worse than the record for other districts."

"In looking back, one can see that IADP's failure to insist on the use of whole farm plans, technical assistance for irrigation and land improvement, and research to provide new technology proved to be major errors of strategy." The results in terms of impacts on institutions and policies were more favorable. "One of IADP's major contributions was the influence it was able to bring to bear on the strengthening of certain institutions and on the evolution of government policy toward agricultural development in general. As IADP work progressed, new and more comprehensive data were uncovered and subjected to analysis. The results of such analysis often brought out factors that had not been considered before or put known facts in a very different light. For example, work with cultivators identified a number of off-farm restraints that affected the success of the technology used and altered benefit-cost relationships, the distribution of supplies, and administrative organization, procedures, and policies. Although IADP was not alone in this field, still it was able to make suggestions for change, some of which were translated into policy and which affected not only the IADP districts, but all of agricultural India."

"Because of the IADP and other Third Plan actions, India is now much better prepared and is making progress in increasing food grain output."

This reviewer accepts as an overall evaluation of Brown's book, the concluding sentence of the Foreword contributed by S. R. Sen: "Even those who may not accept all his conclusions must agree that his evaluation of the IADP is a valuable contribution to the subject of agricultural modernization, and one which should provide very useful guidelines not only to those who are interested in the Indian experiment but also to others who are seeking to initiate a process of modernization in a traditional agriculture wherever it exists."

Louis F. Herrmann

The Vanishing Peasant: Innovation and Change in French Agriculture

By Henri Mendras. The MIT Press, Cambridge. 289 pages. 1971. $8.95.

Mendras has combined his erudition and first-hand knowledge of French farmers to produce a text with many interesting perspectives. Over 200 sources are listed in this book's appendix and bibliography. The major world problem facing the social sciences, according to Mendras, is the 2 billion peasants who will vanish into the industrial civilization. By studying the example of Western peasants who have already made this transition, insight may be gained on how to help peasants all over the world adapt themselves to industrial civilization. Although the path from the traditional to the industrial society is not always the same, the fundamental facts of the problems are the same everywhere, according to the author. The traditional theory of economic development is not presented in this book, i.e., the industrial revolution (forces from outside the peasant sector) led to the gradual disappearance of the peasant society. Rather, the view presented is that the peasant's disappearance was in large part the result of forces from within the traditional society.

While this book need not be on "every social scientist's reference shelf," it should be borrowed from the library because of chapter 4—"An Innovation: Hybrid Corn." In this chapter, a concrete example is used to show the forces that have an impact on traditional farmers. The traditional peasant is disoriented by an innovation because he perceives that the ultimate result is a complete upheaval of his system of economic, social, and moral life. By analyzing the innovation of hybrid corn in France, Mendras attempts to show that a farmer makes the choice of whether to adopt hybrid corn in terms of individual morality or by yielding to the trends of fashion, but never by economic reasoning.

The author gives an excellent account of the paradox brought on by hybrid corn. Farmers feel this corn will kill agriculture in their region when actually it would bring an increase in their income. Peasants who have maintained their fierce independence from those in power believe that hybrid corn threatens to destroy this freedom by making them more dependent on other segments of the agricultural economy. In sum, farmers feel that it is not a matter of one variety of corn replacing another, but that they must choose between dying with the traditional self-sufficient peasant economy or being destroyed by technical and economic progress required for mass production for the market. The ultimate doom of the peasant civilization is brought on by "the others," or "them," whom the peasants berate for not "leaving us alone."

Readers who have time to read the other chapters and the appendix, which discusses some of the factors involved in interviewing the traditional peasants, should do so. Readers with limited time may want to read (in addition to chapter 4) the conclusion where Mendras outlines his perspectives on the future. In his conclusion, the author's view is much broader than just French farming.

Few problems stand in the path of the young farmer of the traditional system who is moving to a system based on economic motivation, if the farmer can understand his changing situation and see how it will permit a successful future. Thus, the world, the author feels, can move away from peasantry, but what would a world without peasants be?

Reading *The Vanishing Peasant*, one gets the impression that the peasants could be compared to Marshal Blücher and his Prussians and that social scientists could be compared to the Duke of Wellington and his thin red line. For two long days, the British under Wellington at Waterloo waited anxiously for word of the Prussians under Blücher. With no radio or reconnaissance planes, Wellington could only wait and hope that Blücher had turned toward Waterloo rather than toward Berlin. Blücher eventually turned up at the right time in the right place and thus gave Wellington a niche in history.

The vanishing peasants may eventually turn up in the industrial civilization, but the latter-day Wellingtons (social scientists) may be unaware of this transition until that time.

William P. Roenigk

Economics of Consumer Protection

Edited by Loys L. Mather. Farm Foundation. Order from The Interstate Printers and Publishers, Inc., Danville, Ill. 148 pages. 1971. $5.50.

This is a good book. Unfortunately for the agricultural economist, the book ranges far in the field of consumerism with little mention of the farmer's problems. But it has a happy ending: It dips briefly into marketing, and so it has some bearing on the farmer after all.

The contents of the volume are based on a seminar sponsored by a North Central Regional Committee (NCR-20) in May 1970. The objectives were to stimulate interest, discussion, and research on the economics of consumer protection. The papers are formal and generally well prepared. Major topics are the consumer movement, consumer action programs, consumer research, consumer education, and policy alternatives.

Of the 19 authors, 11 are college professors and one is a research assistant, all in Departments of Agricultural Economics or Business Administration. Two are in USDA. One is a family extension economist. The remaining four are prominent in the Federal Trade Commission, President's Commission on Consumer Interests, Consumers Union of the United States, and New York Institute for Consumer Education and Development.

Papers by administrators tend to be descriptive and at the same time defensive of their consumer protection policies, practices, and programs. Some, but not all, of the papers by university writers are fairly academic. At least one paper is in the vein of that widely circulated monthly digest: It is a case study of the adventures of the fraudulent "Dr. K." Perhaps of most direct interest to agricultural economists are the two papers near the end on unit pricing of grocery items, the first concerning a market test and the second a commentary.

Robert M. Walsh

Economic and Social Development: A Process of Social Learning

By Edgar S. Dunn, Jr. Published for Resources for the Future, Inc., by The Johns Hopkins Press, Baltimore. 327 pages. 1971. $10.

Judging from the title of this book, one would think that its contents could be a new addition to the current varied research on growth and development. Any new thought or technique which could more effectively resolve the complex problems associated with regional and national development would undoubtedly be welcomed by all persons involved in economics. One also would think that the author, Edgar S. Dunn, Jr., would be a likely person to offer an important contribution. His credentials are impressive. He is senior research associate with Resources for the Future, Inc., and was Deputy Assistant Secretary for Economics Affairs of the U.S. Department of Commerce.

After reading the book, however, this reviewer must admit that he was somewhat disappointed. The book seemed to be a philosophic dissertation rather than a manual of instruction. The author particularly criticizes the inadequacies of positive economic techniques, which he writes off in effect as not possessing sufficiently accurate instrumentality to gage growth processes.

The major thrust of his attack is at the key attribute of the discipline's technique: The development of "law-like" statements to support predictions. The author contends that conventional predictive models over time and involving significant changes are impossible to construct. The use of carefully designated assumptions and the arbitrary exclusion of unknown or exogenous variables could make the outcome predetermined at the outset. Even despite the fact that in the model there could be extensive variation in parameters, the structure of the system remains unchanged.

The author therefore concludes that positive economics should be discarded as a practical technique. He instead advocates that there should be a move toward evolutionary experimentation, that is, there must be an introduction of learning models into the analyses of the process. Economic and social development could better be understood through social science analysis and with knowledge of human organization.

This is a striking statement to hear from an economist. It is generally agreed that the ability of the positive economic method to restrict the influence of the human variable to a minimum permits more accurate results. Therefore, it is difficult for this reviewer to understand that to permit immeasurable, complex human variables to be the major key to an analysis enables one to predict with more exactitude where society will be in the future.

Jack Ben-Rubin

The World's Landscapes: New Zealand

By Kenneth B. Cumberland and James S. Whitelaw. Aldine Publishing Company, Chicago. 194 pages. 1970. $5.95.

Geographers, notably economic geographers, are providing descriptive, statistical, and economic material that can be of value to economists. The present volume should be consulted by anyone concerned with the agricultural development of New Zealand.

The Consumer in American Society: Personal and Family Finance

By Arch W. Troelstrup. Fourth Edition. McGraw-Hill Book Company, New York. 668 pages. 1970. $9.95.

This widely used textbook on consumer education devotes two chapters to food shopping and management. The consumer viewpoint presented might well be considered by the agricultural economist concerned with marketing.

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